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DOD BUDGET DATA ANALYZED BY

ROBUST REGRESSION TECHNIQUES

by

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This paper describes the application of modern robust/resistant regression techniques to DOD budget data. Sampling experiments to evaluate certain estimating procedures are also summarized.

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DOD BUDGET DATA ANALYZED BY ROBUST REGRESSION TECHNIQUES

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1. Background

The relationship between budget requests by governmental agencies and subsequent Congressional appropriations has come to be of increasing interest to planners and students of the public sector. Analysis has either focussed on the opinions of participants in the budgetary process, or has explored the use of simple linear models to describe this relationship; see [8,15,4,5]. Quantitative models of the request-appropriations relationship have in general been of the form

$$Y_t = \beta x_t + \varepsilon_t \tag{1.1}$$

where Y_t is the appropriation for year t, x_t is the request for year t, and ε_t is a stochastic disturbance, with

$$E[\varepsilon_t] = 0 \ , \quad Var[\varepsilon_t] = \sigma^2 \ , \quad Cov[\varepsilon_t, \varepsilon_{t'}] = 0 \quad \text{for} \quad t \neq t' \ .$$

It may reasonably be argued that (1.1) does not capture the complex subtlety of the budgetary process, nor do <u>any</u> simple models answer many of the possible questions about the relationship of appropriations to requests. However, as we will show, use of models akin to (1.1) to analyze budgetary data in an exploratory spirit reveals regularities and trends, and can help to raise questions about the budget process through the identification of departures from these regularities and trends.

2. The Data, Alternative Models, and Preliminary Estimates

This study is concerned with an analysis of two sets of U.S. Department of Defense budgetary data.

(1) Procurement data, including procurement of Army equipment and missiles (PERMA), procurement of Navy aircraft and missiles (PAMN), procurement of Air Force aircraft (AFAC), and procurement of Air Force missiles (AFM) for the years 1953-1973, but omitting the PEMA category for years 1955-1958 because the data were missing: a total of 80 observations on budget requests and subsequent appropriations. The 1953-1968 data were taken from Stromberg [14], who reconciled earlier budget categories with those of 1968. Later data were obtained from Budget Estimates and Appropriations, U. S. Senate, 1969-1973, and also reconciled with 1968.

(2) Research and Development data, including research, development, training, and education (RDTE) requests by Army, Navy, and Air Force and subsequent appropriations for 1953-1973; there were a total of 63 observations on budget requests and appropriations. Data sources were the same as for the procurement data.

Previous studies of budgetary phenomena, e.g. by Davis, Dempster, and Wildavsky [5] and Stromberg [14], have generally employed models similar to (1.1) in order to describe Congressional appropriation behavior in a simple manner. Parameters, i.e. β , were fitted using least-squares techniques. Our approach is comparable, but we have (i) entertained a variety of admittedly simple models, but somewhat more elaborate than (1.1); (ii) utilized robust/resistant fitting routines appropriate when disturbances appear with long, fat, non-normal tails, cf. Andrews [2], Huber [9]; and (iii) studied residuals from the fits with the objective of uncovering evidence of historically consistent or exceptional behavior otherwise concealed in the data.

The alternative models fitted to the data are listed in Table 1. These models were adopted because they represent certain plausible data behaviors in the present context. For instance, it seems natural that appropriation size be related to request, and more specifically to ask whether, and how, the percentage of request granted varied with request size. One may also ask how the residuals, as represented by terms containing fluctuations ε_t, seem to be related to request size. Other questions and observations are suggested once preliminary fits are performed.

TABLE 1

Models Fitted

$$Y_t = \beta x_t + \varepsilon_t \tag{2.1}$$

$$Y_t = \beta x_t + x_t\varepsilon_t = (\beta+\varepsilon_t)x_t \tag{2.2}$$

$$Y_t = \beta x_t e^{u_t} \tag{2.3}$$

$$Y_t = \beta x_t^{\alpha} e^{u_t} \tag{2.4}$$

$$Y_t = \beta x_t^{\alpha} e^{u_t \ell n x_t} = \beta x_t^{\alpha+u_t} \tag{2.5}$$

where Y_t represents Congressional appropriations ($) in the category under study in year t, x_t is DOD request in year t, ε_t and u_t are uncorrelated stochastic disturbances with zero means and constant variances.

Parameters in the models were estimated (a) by normal-theory (on ε_t)-guided maximum likelihood or least squares (LS), and (b) by Huber M technique (HM) of [9]. The resulting point estimates appear in Table 2. See Appendix 1 for details concerning the computational procedure. The reader is reminded that HM is a fitting approach that diminishes the effect of aberrant or exotic observations upon the fitted parameters, in this case β and α.

TABLE 2

	Procurement			
	Least Squares		Huber M	
Equation	$\hat{\beta}$	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\alpha}$
(2.1)	.959	-	.961	-
(2.2)	.993	-	.969	-
(2.3)	.977	-	.963	-
(2.4)	1.473	.948	1.110	.982
(2.5)	1.242	.969	.997	.996
	RDTE			
	$\hat{\beta}$	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\alpha}$
(2.1)	.982	-	.977	-
(2.2)	1.093	-	.989	-
(2.3)	1.025	-	.989	-
(2.4)	2.028	.903	1.061	.990
(2.5)	2.877	.852	1.029	.994

Equations (2.4) and (2.5) imply that the percentage of the request granted, $\beta x^{\alpha-1}$, depends on the size of request, while equations (2.1) through (2.3) imply that the percentage is not related to the size of the

request. In order to compare results, the estimated percentages of the requests granted were examined. The means of those percentages are shown in Table 3.

TABLE 3

Equation	Least Squares	Huber M
	Procurement:	
(2.4)	.981	.968
(2.5)	.975	.969
	RDTE	
(2.4)	1.028	.974
(2.5)	1.031	.989

Table 3: mean values for $\hat{\beta} x_t^{\hat{\alpha}-1}$ using observed values for x_t .

One notes immediately that for both data sets and for all models $\hat{\beta}_{LS} > \hat{\beta}_{HM}$. Furthermore, the $\hat{\beta}_{HM}$-values for models (2.1 - 2.3) differ much less than do the corresponding $\hat{\beta}_{LS}$-values. Similar comments apply to the parameter estimates in (2.4) and (2.5). These numerical facts, reinforced by data plotting, suggest that exceptional data points are unrealistically influencing the LS-fitted parameters: one anticipates that as a rule requests will be trimmed, while the fits of (2.2) and (2.3) to RDTE indicate the contrary.

3. Stability of Parameter Estimates

The apparent systematic differences between the parameter estimates obtained by LS and HM fitting techniques suggest that an assessment of statistical stability be made. Confidence limits at the nominal 95% level were constructed in the following ways.

(a) Under conventional normal-theory assumptions.

(b) By means of the jackknife; see Miller [12].

(c) For the HM estimates by utilizing the Huber approximation, [9], for obtaining the approximate variance of a robust estimator.

(d) By jackknifing the HM-obtained estimates. The latter procedure was validated empirically by experimental sampling.

The results of the conventional LS analysis are contained in Table 4; those for the robust methods appear in Table 5. Examination of Table 4 reveals the profound effect that a few outlying observations may have upon confidence limits computed under normal theory assumptions: these limits become excessively wide--especially is this true for the models (2.4) and (2.5). Hence the robust methods, that react less dramatically than LS to the appearance of outliers, were once again suggested.

TABLE 4

95.45% Confidence Limits via Normal Theory

	Procurement		RDTE	
	β	α	β	α
(2.1)	(.93,.99)		(0.96,1.00)	
(2.2)	(.95,1.04)		(0.90,1.28)	
(2.3)	(.94,1.02)		(0.80,1.32)	
(2.4)	(.88,5.21)	(.79,1.11)	(2.01,3.03)	(-.75,2.15)
(2.5)	(0 , "∞")	(-1.42,3.36)	(0 , "∞")	(-.46,2.16)

The conventional measures of model fit, namely the (multiple correlation)^2 or R^2, are all high, as is to be expected from examination of the graphs. For instance $R^2 = 0.90$ for model (2.1) fitted to procurement data, and 0.97 for RDTE, while $R^2 = 0.91$ for model (2.4) fitted to procurement data, and 0.92 for RDTE. Nevertheless, the data have more to suggest than the adequacy of a simple model; a further discussion appears in Section 4.

The process of jackknifing revealed observations that exerted an extreme effect on certain LS estimates for the RDTE data. The effect became noticeable from normal probability plotting of the pseudo-values. Consequently on a second iteration the exotic observations were omitted from the LS computations for RDTE. A similar examination of the corresponding procurement data pseudo-values revealed an observation that strongly affected both LS and HM estimates. This observation was omitted before computing the confidence limits of Table 4.

Certain aspects of the results of this stage of the analysis were notable.

(i) The approximate HM, and the jackknifed HM, confidence limits agree closely for models (2.1), (2.2), and (2.3), and reasonably well for (2.4) and (2.5). All confidence limits are somewhat tighter than are those obtained by jackknifing the LS estimates.

(ii) The confidence intervals for β in models (2.4) and (2.5) obtained from Huber's approximation are shorter than are those from the jackknifed LS . In the RDTE results the short LS intervals for (2.1), (2.2), and (2.3) result from omitting some apparently extreme observations; these were not omitted before computing HM intervals. The HM procedure automatically down-weights such observations.

(iii) The estimates of α for both models (2.4) and (2.5) are quite consistent, locating α at a value slightly less than unity. LS produces a larger β and a smaller α than does HM .

(iv) The confidence intervals for β in (2.4) and (2.5) tend to be rather long as compared to those for β in the earlier models. However, the interpretation of β in models (2.1)-(2.3) differs from that in models (2.4) and (2.5).

TABLE 5

95.45% Confidence Limits

Procurement

	Jackknifed LS		Jackknifed HM		Huber's Approximation	
	β	α	β	α	β	α
(2.1)	(.93,.99)		(.92,.97)		(.94,.98)	
(2.2)	(.95,1.04)		(.94,.99)		(.95,.99)	
(2.3)	(.94,1.01)		(.94,.97)		(.94,.99)	
(2.4)	(.32,3.23)	(.81,1.01)	(.81,1.88)	(.91,1.01)	(.90,1.98)	(.91,1.01)
(2.5)	(.21,3.45)	(.80,1.01)	(.74,1.79)	(.91,1.13)	(.90,1.95)	(.91,1.01)

RDTE

	Jackknifed LS		Jackknifed HM		Huber's Approximation	
	β	α	β	α	β	α
(2.1)	(.95,1.01)		(.96,.99)		(.96,.99)	
(2.2)	(.98,1.04)		(.97,1.00)		(.97,1.00)	
(2.3)	(.97,1.03)		(.97,1.00)		(.97,1.00)	
(2.4)	(.94,1.50)	(.94,1.00)	(.75,1.32)	(.95,1.03)	(.91,1.24)	(.97,1.01)
(2.5)	(.92,1.44)	(.95,1.01)	(.67,1.38)	(.94,1.04)	(.89,1.18)	(.97,1.01)

4. Eras of Congressional Behavior: Evidence from Residual Analysis

As we have stated, the fitting of models (2.1)-(2.5) is useful in that overall trends in the budgetary activity are revealed. Indeed, the overall fit and agreement of such models is striking. However, additional questions arise which may be addressed once the various fits are constructed. Among these are the following:

(1) Does the data contain any evidence of change in the general relationship between request and appropriation over the time period covered?

(2) Did the services (Army, Navy, Air Force) fare about equally well at the hands of Congress over the time period of the data?

A detailed examination of the residuals (residual = actual appropriation minus model-projected appropriation) was conducted in order to reach tentative answers to these questions, and to suggest others. Since the robust HM tends to follow the main body of the data more faithfully than does LS, HM residuals were the objects of our examination. Noticeable effects were the following:

(a) For both the procurement and RDTE data, HM residuals for observations <u>after 1969</u> were, almost without exception, negative. This tends to suggest a generally more critical Congressional attitude following 1969 -- the latter date perhaps representing the end of an era.

(b) For the period before 1960 fits of the procurement data gave rise to residuals relatively large in size, but with about as many positive as negative. This suggests that models are not working very well for this set of data.

(c) The residuals associated with Air Force RDTE were positive, almost without exception, for the period 1957-1969. This may imply that the Air Force program was, comparatively speaking, more appealing to Congress during this period.

The fitting results give definite evidence of change in the relationship of appropriation to request, with the change occurring in 1969. Prior to that date, and certainly after 1959, Congress was, "on the average," appropriating at a level nearly equal to requests: procurement β was close to or slightly in excess of unity, while RDTE β was slightly less than unity for the models (2.1)-(2.3). The same pattern held true for models (2.4)-(2.5) for procurement, while α-values were very nearly unity.

For the procurement data, and for the 1969-1973 period, the value of β estimated for models (2.1)-(2.3) fell to about 0.9 (from unity). For models (2.4)-(2.5) the estimated β-value rose to about 1.61, but the α-value fell to about 0.93 (from nearly unity). The indications are that during the later period studied larger requests were cut somewhat more heavily than were smaller requests. These results are consistent with and add to the results of recent research on roll-call voting in the Senate [11] which notes a change in the attitude of the Senate toward defense budget requests starting with the review of the fiscal 1969 budget request. This change was noted especially in those accounts reviewed by the Senate Armed Services Committee: procurement and RDTE. The reason why the change occurred at this time is not entirely clear. The fiscal 1969 budget was submitted in January 1968 and reviewed throughout the year. One hypothesis is that legislators were either responding to or anticipating the pressures of the 1968 elections.

For the procurement data in the period prior to 1960, the confidence intervals for the coefficients are large in comparison to confidence intervals for other groups of data. Examination of the data reveals that during this period Congress was in many cases cutting Air Force procurement and adding to Army and Navy procurement, possibly reflecting differences in strategic philosophy

between the Executive and the Congress. A survey of literature concerning this period reveals the existence of major differences in strategic philosophy between the President and the Joint Chiefs of Staff; see [10]. However there is no discussion of such differences between the President and the Congress. A further analysis for the data in this period, separating Air Force from the rest, is perhaps indicated but was not conducted.

For the RDTE data, and for the 1957-1968 time period, the β-value estimated was well above unity, while that for other services was close to 0.99. Since the coefficients for Navy and Army RDTE are nearly unity, differences between these services and the Air Force are not due to the fact that the proposed Air Force program was more appealing, but are the result of Congressional increases over and above the proposed program. As a result of the differences noted in the 1957-1969 time frame between Air Force RDTE and Army and Navy RDTE, Armed Services and Appropriations Committee Reports were reviewed in order to determine a possible explanation for the differences. Committee reports reveal that during this period there were major differences in the views of the Congress and the Executive over such projects as the B-70 bomber and the advanced manned orbiting laboratory. During the period in question, funds were added to Air Force requests for these projects.

Observations (a)-(c) led to our re-fitting the models: point and interval parameter estimates were computed for post-1968 procurement and RDTE, for pre-1960 procurement, and for 1957-1969 Air Force RDTE. These estimates are exhibited in Tables 6 and 7; we do not include commentary on the residuals of the resulting fits; see [4] for details.

TABLE 6

Point and Interval Estimates for Procurement Data by Eras

	1953-1959		1960-1968		1969-1973		Full Data	
	β	α	β	α	β	α	β	α
(2.1)	.959 (.879,1.040)		.999 (.978,1.021)		.889 (.866,.912)		.961 (.938,.983)	
(2.2)	.959 (.867,1.050)		1.010 (.982,1.038)		.903 (.876,.930)		.970 (.946,.994)	
(2.3)	.952 (.865,1.049)		1.010 (.982,1.038)		.902 (.875,.930)		.969 (.943,.995)	
(2.4)	2.472 (.317,19.314)	.874 (.606,1.143)	1.044 (.670,1.627)	.996 (.939,1.052)	1.607 (.943,2.740)	.928 (.862,.995)	1.336 (.902,1.981)	.958 (.909,1.009)
(2.5)	2.579 (.419,15.870)	.869 (.630,1.106)	1.011 (.663,1.542)	1.000 (.945,1.055)	1.620 (.972,2.702)	.927 (.863,.991)	1.328 (.904,1.952)	.960 (.910,1.009)

TABLE 7

<u>Point and Interval Estimates for RDTE Taking Into Account AF Uniqueness and Post-1968 Cuts</u>

	AF (1957-1969)		1953-1968 less AF 1957-1968		1969-1973 less AF 1969		Full Data	
	β	α	β	α	β	α	β	α
(2.1)	1.017 (.976,1.059)		.990 (.976,1.003)		.938 (.912,.964)		.977 (.965,.989)	
(2.2)	1.066 (1.001,1.130)		.993 (.977,1.008)		.936 (.911,.962)		.989 (.973,1.004)	
(2.3)	1.063 (1.000,1.130)		.992 (.977,1.008)		.935 (.909,.962)		.989 (.973,1.004)	
(2.4)	1.919 (1.010,3.645)	.922 (.838,1.006)	.944 (.814,1.094)	1.007 (.986,1.029)	.962 (.379,2.441)	.996 (.876,1.116)	1.061 (.911,1.236)	.990 (.969,1.011)
(2.5)	1.782 (.961,3.306)	.932 (.849,1.015)	.901 (.799,1.015)	1.014 (.996,1.033)	.923 (.362,2.349)	1.002 (.881,1.122)	1.029 (.893,1.185)	.994 (.974,1.014)

5. Summary

In this paper we have explored two sets of data originating in defense political economy by means of robust fitting techniques and examination of the resulting residuals. An attempt has been made to explain the appearance of the residuals from original fits as the latter reflect historical events; a second round of fits was carried out as a consequence of the first. Certainly alternative approaches to the data suggest themselves, as is likely to be the case in many similar circumstances: for instance graphical and numerical analysis of such re-expressed responses as (i) appropriation - request, or (ii) appropriation ÷ request (actually used for fitting (2.2)) might well be useful, as might use of a Huber ψ-function that more severely down-weights extreme observations than does ours. Nevertheless the present approach appears to illuminate events of the past, and provides an impetus for further investigations.

APPENDIX 1

The Huber M Estimation Procedure

The Huber "M" (here HM) robust/resistant estimator is one of many that have been suggested for parameter estimation when extreme, aberrant, or exotic observations occasionally occur; see Andrews, et al. [1], Andrews [2], Tukey and Beaton [3]. It may be motivated as follows. Suppose $p(\cdot)$ is the density function of disturbance terms ε_t or u_t in which S represents scale, and write down the log-likelihood, e.g. for model (2.1), which we shall use for illustration:

$$L(\beta,S) = \sum_{t=1}^{T} \log \left\{ p\left(\frac{y_t-\beta x_t}{S}\right)\frac{1}{S}\right\} \qquad \text{(A 1.1)}$$

differentiation yields the necessary condition for a minimum

$$\frac{\partial L}{\partial \beta} = \sum_{t=1}^{T} x_t \frac{p'\left(\frac{y_t-\beta x_t}{S}\right)}{p\left(\frac{y_t-\beta x_t}{S}\right)}\left(-\frac{1}{S}\right) = 0 \qquad \text{(A 1.2)}$$

or, putting $\frac{p'(z)}{p(z)} = -\psi(z)$,

$$\sum_{t=1}^{T} x_t \psi\left\{\frac{y_t-\beta x_t}{S}\right\} = 0 \qquad \text{(A 1.3)}$$

For the normal distribution $\psi(z) = z$, while for long-tailed distributions, e.g. the Cauchy, $\psi(z)\to 0$ if $|z|\to\infty$. A compromise, adopted in this paper's analysis, is to choose $c > 0$ (actually $c = 1$ in our analyses)

$$\psi(z) = \begin{cases} -c \text{ for } & z < -c \\ z \text{ for } & -c < z < c \\ c \text{ for } & z > c \end{cases}$$

In order to solve for β and for S it is necessary to use an iterative procedure. That described by Huber ([9], p. 816) was adopted for use. Another approach, based on iteratively re-weighted least squares, see Andrews [2], is perhaps somewhat more convenient.

APPENDIX 2

Monte Carlo Investigation of Jackknifed HM Confidence Intervals

To our knowledge the properties of confidence limits constructed by jackknifing HM regression coefficients have not been studied, and so we undertook a modest investigation for our particular models. The plan of the investigation was as follows.

(a) A value of β of 0.989, and of α of 1.000 (required in (2.4) and (2.5)) specified the basic regression models. The scale of the disturbance distribution, i.e. that of ε_t or u_t, was chosen to be the median of the absolute values of the residuals resulting from the analysis of actual data.

(b) The disturbance distributions were chosen to be Cauchy:

$$P\{\varepsilon_t \varepsilon (dx)\} = \frac{dx}{\pi(x^2+a^2)} \cdot \frac{1}{a}$$

where a is the scale parameter referred to in (a).

(c) One thousand simulated confidence limits were constructed using the above structure for each model (with one exception: only 614 sample confidence limits were constructed for model (2.5) owing to computational expense). In these particular simulations it was assumed that the correct model--the one giving rise to the (simulated) data--was known when confidence limits were computed. We shall discuss similar results for the misspecification (wrong model) situation shortly. In the case of the jackknife computed limits, pseudo values were computed for each parameter leaving out one (x_t, y_t) variable pair at a time, and then the latter were treated as normal and independent and the mean and standard deviation of the pseudo values were computed. From these the coverage and interval properties were found.

TABLE 8

Simulated Coverage of Nominal 95.45% (two-sigma) Confidence Intervals

	Jackknifed Interval				Huber's Approximation			
	Coverage*		Mean Length (Standard Dev. of Length)		Coverage*		Mean Length (Standard Dev. of Length)	
	β	α	β	α	β	α	β	α
(2.1)	95.9	NA	.038 (.012)	NA	84.4	NA	.026 (.006)	NA
(2.2)	97.3	NA	.033 (.007)	NA	96.1	NA	.032 (.007)	NA
(2.3)	97.4	NA	.033 (.007)	NA	96.3	NA	.032 (.007)	NA
(2.4)	96.7	96.9	.272 (.111)	.039 (.014)	93.4	93.5	.249 (.057)	.035 (.008)
(2.5)**	94.8	95.0	.273 (.113)	.039 (.015)	87.4	88.2	.203 (.055)	.030 (.008)

(with approximately 95% confidence the true coverage is within ±.014 of the sample coverage, assuming the normal approximation to the binomial)

*Coverage refers to percentage of 1000 confidence intervals which covered true parameter value. For (2.4) and (2.5) true value for α was 1.0.

**Because of expense of computation, jackknifed values based on 614 confidence intervals.

It is noticeable that the jackknifed intervals obtained by sampling cover with quite closely the nominal coverage (95.45%). The intervals based on Huber's approximation have some tendency to under-cover, but on the whole do quite well, and are somewhat less expensive to compute than are the jackknifed intervals. Not surprisingly in view of the above, the Huber-approximation intervals run somewhat shorter than do the jackknife intervals.

From a practical viewpoint one cannot assume that the data obtained "realize" the model used in the analysis. In order to address this question, we have sampled from one model (model 2.4) and analyzed the data as if it arose from our various alternatives.

In summary: Confidence limits constructed using the jackknife on the alternative (incorrect) models cover the true parameter value rather adequately, while those obtained using Huber's approximation tend to under cover. Further investigations on this point are needed. For other sampling experiments on this mis-specification problem reported in more detail, see Capra [4].

APPENDIX 3

Procurement Data

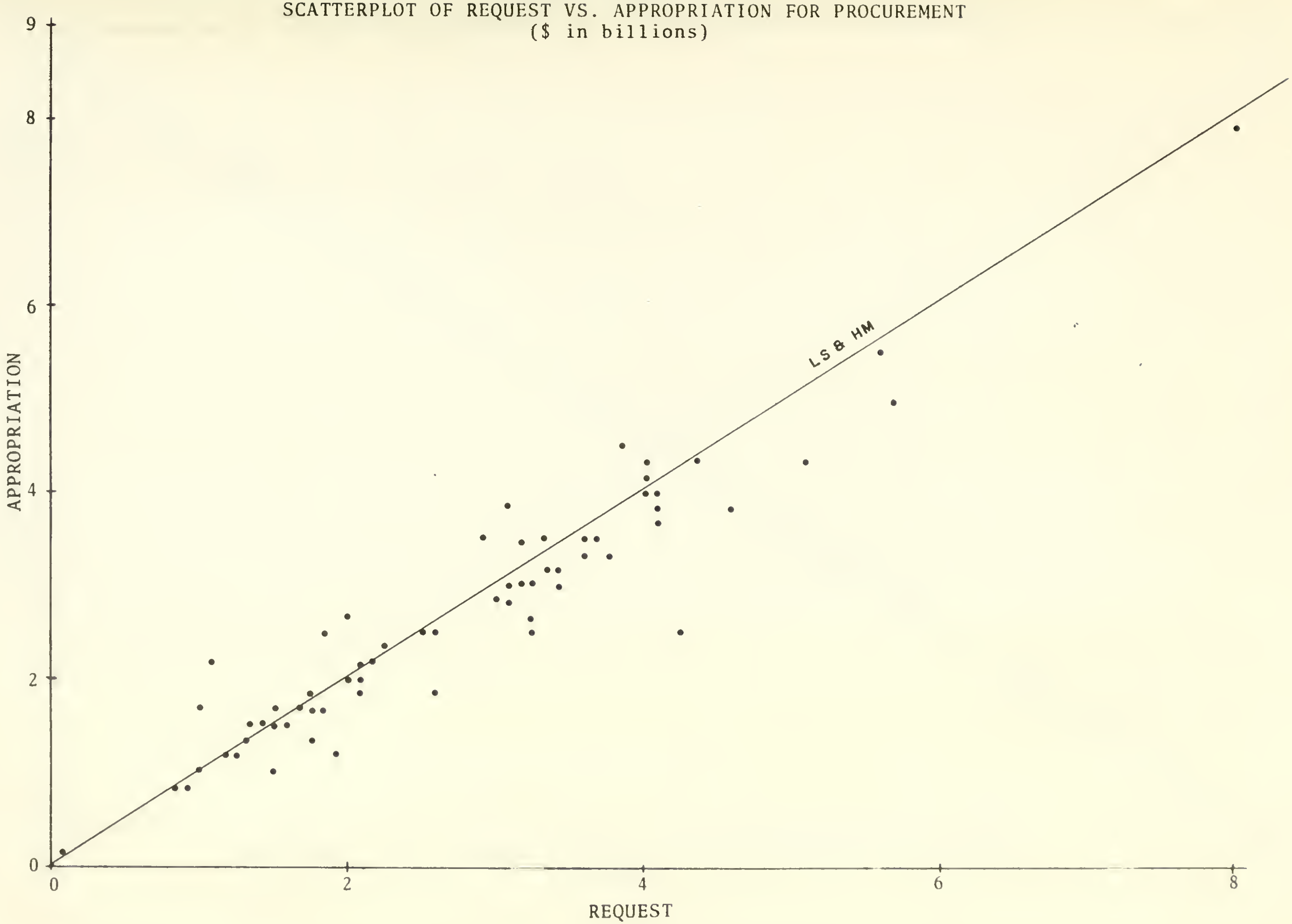
APPROPRIATIONS	REQUEST	
1889.2000	2544.4000	1953PEMA
2226.6000	1070.7000	1954PEMA
1669.3000	970.1000	1959PEMA
971.7000	1024.7000	1960PEMA
1495.3000	1337.0000	1961PEMA
2532.6000	1803.0000	1962PEMA
2520.0000	2555.0000	1963PEMA
2931.1000	3202.0000	1964PEMA
1656.4000	1779.0000	1965PEMA
1204.8000	1223.1000	1966PEMA
3483.3000	3311.1000	1967PEMA
5462.5000	5581.0000	1968PEMA
5031.4000	5626.0000	1969PEMA
4254.4000	5069.1000	1970PEMA
2958.5000	3226.0000	1971PEMA
3407.3000	3719.4000	1972PEMA
3025.0000	3439.1000	1973PEMA
113.5000	124.5000	1953PAMN
1222.8000	1924.2000	1954PAMN
1944.7000	2030.8000	1955PAMN
804.5000	945.2000	1956PAMN
1696.2000	1703.4000	1957PAMN
1724.9000	1852.3000	1958PAMN
2129.3000	2083.9000	1959PAMN
2044.6000	2114.1000	1960PAMN
2144.1000	2114.9000	1961PAMN
2680.9000	2000.0000	1962PAMN
3834.7000	3065.0000	1963PAMN
2889.1000	3066.0000	1964PAMN
2496.3000	2515.8000	1965PAMN
2272.5000	2279.8000	1966PAMN
1789.9000	1789.9000	1967PAMN
2939.1000	3046.0000	1968PAMN
2574.3000	3222.0000	1969PAMN
2620.0000	3235.5000	1970PAMN
3117.9000	3427.7000	1971PAMN
3955.0000	4069.1000	1972PAMN
3696.3000	4118.6000	1973PAMN
2453.7000	4283.0000	1954AFAIRCR
2072.4000	2098.8000	1955AFAIRCR
4128.8000	4031.0000	1956AFAIRCR
4533.1000	3859.9000	1957AFAIRCR
3914.9000	4122.9000	1958AFAIRCR
4288.4000	4012.8000	1959AFAIRCR
4284.6000	4322.8000	1960AFAIRCR
3497.2000	2934.1000	1961AFAIRCR
3537.2000	3136.2000	1962AFAIRCR
3562.4000	3135.0000	1963AFAIRCR
3385.6000	3559.0000	1964AFAIRCR
3563.7000	3663.0000	1965AFAIRCR
3517.0000	3550.2000	1966AFAIRCR
4017.3000	3961.3000	1967AFAIRCR
5493.4000	5582.0000	1968AFAIRCR
3860.0000	4612.0000	1969AFAIRCR
3405.8000	3775.2000	1970AFAIRCR
3219.3000	3314.9000	1971AFAIRCR
2942.3000	3116.5000	1972AFAIRCR
2682.3000	3255.7000	1973AFAIRCR
2903.8000	3012.1000	1953AFMISSI

APPROPRIATIONS	REQUEST	
936.9000	1509.5000	1954AFMISSI
812.7000	830.2000	1955AFMISSI
1475.4000	1449.5000	1956AFMISSI
1695.5000	1483.9000	1957AFMISSI
1500.7000	1578.7000	1958AFMISSI
1394.2000	1722.1000	1959AFMISSI
2540.5000	1832.1000	1960AFMISSI
1837.6000	2124.9000	1961AFMISSI
1928.7000	1975.2000	1962AFMISSI
2459.0000	2500.0000	1963AFMISSI
2141.9000	2177.0000	1964AFMISSI
1730.0000	1730.0000	1965AFMISSI
796.1000	796.1000	1966AFMISSI
1189.5000	1189.5000	1967AFMISSI
1340.0000	1343.0000	1968AFMISSI
1720.2000	1768.0000	1969AFMISSI
1448.1000	1486.4000	1970AFMISSI
1427.2000	1530.6000	1971AFMISS
1683.7000	1837.4000	1972AFMISS
1705.0000	1816.8000	1973AFMISS

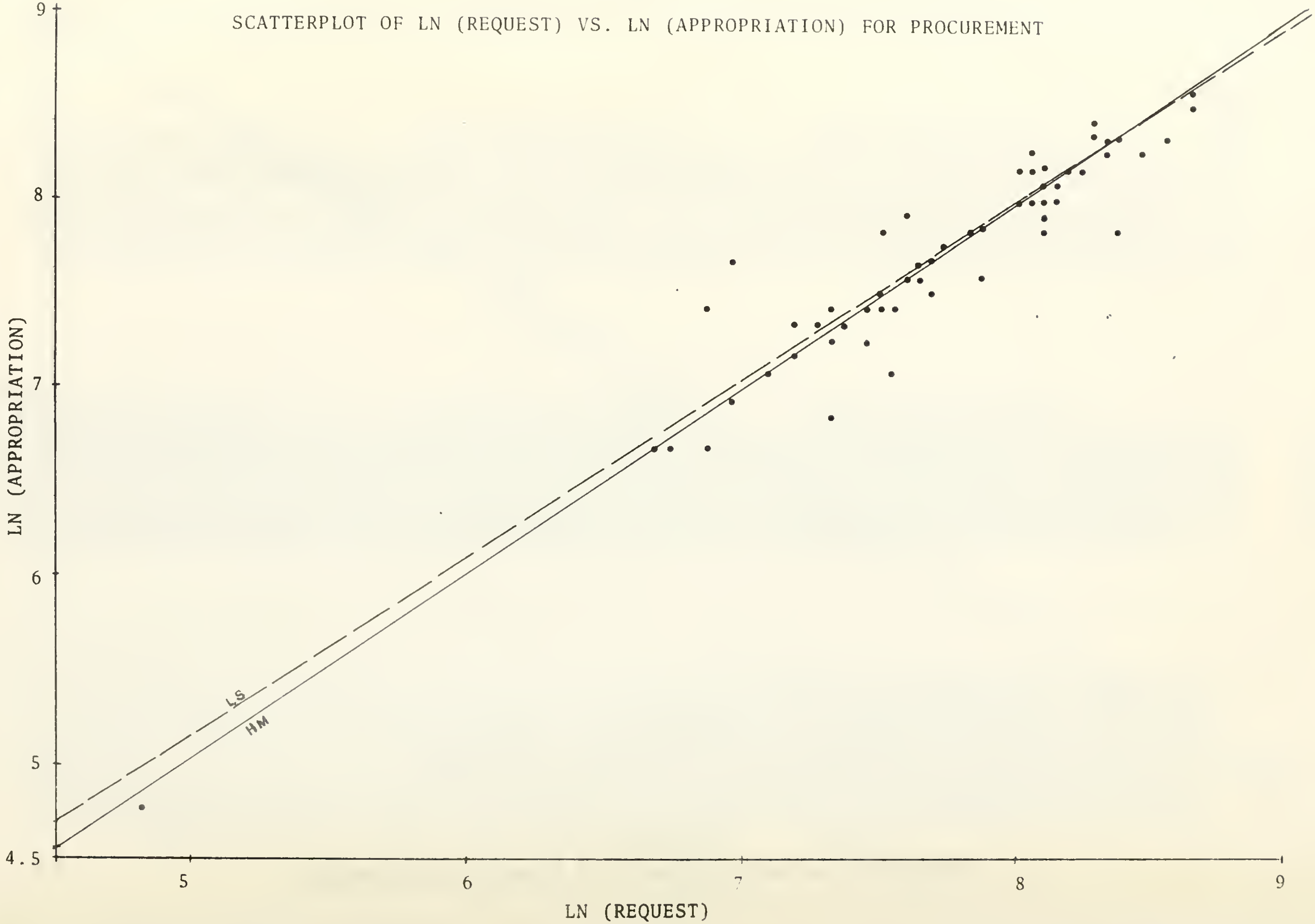
RDTE DATA

APPROPRIATIONS	REQUEST	
440.0000	450.0000	1953 ARDTE
345.0000	475.0000	1954 ARDTE
345.0000	355.0000	1955 ARDTE
333.0000	333.0000	1956 ARDTE
410.0000	410.0000	1957 ARDTE
400.0000	400.0000	1958 ARDTE
498.7000	471.0000	1959 ARDTE
1035.7000	1046.5000	1960 ARDTE
1041.2000	1041.7000	1961 ARDTE
1203.2000	1130.4000	1962 ARDTE
1319.5000	1329.0000	1963 ARDTE
1390.2000	1474.6000	1964 ARDTE
1344.1000	1401.5000	1965 ARDTE
1410.6000	1442.7000	1966 ARDTE
1531.9000	1522.2000	1967 ARDTE
1514.2000	1544.0000	1968 ARDTE
1522.6000	1661.9000	1969RDTEARM
1596.8000	1849.5000	1970RDTEARM
1618.2000	1717.9000	1971RDTEARM
1839.5000	1951.5000	1972RDTEARM
1829.0000	2122.7000	1973RDTEARM
70.0000	75.7000	1953 NRDTE
58.6000	74.9000	1954 NRDTE
419.9000	61.0000	1955 NRDTE
439.2000	439.2000	1956 NRDTE
492.0000	477.0000	1957 NRDTE
505.0000	505.0000	1958 NRDTE
821.2000	641.0000	1959 NRDTE
1015.9000	970.9000	1960 NRDTE
1218.6000	1169.0000	1961 NRDTE
1301.5000	1267.0000	1962 NRDTE
1475.9000	1474.0000	1963 NRDTE
1530.5000	1578.4000	1964 NRDTE
1377.5000	1456.3000	1965 NRTDE
1444.2000	1478.1000	1966 NRTDE
1762.4000	1752.5000	1967 NRTDE
1826.5000	1863.9000	1968 NRTDE
2141.3000	2146.4000	1969RDTENAV
2186.4000	2211.5000	1970RDTENAV
2165.1000	2197.3000	1971RDTENAV
2372.3000	2431.4000	1972RDTENAV
2545.3000	2813.8000	1973RDTENAV
525.0000	525.0000	1953 AFRDTE
440.0000	537.0000	1954 AFRDTE
418.1000	431.0000	1955 AFRDTE
570.0000	570.0000	1956 AFRDTE
710.0000	610.0000	1957 AFRDTE
661.0000	661.0000	1958 AFRDTE
743.0000	719.0000	1959 AFRDTE
1159.9000	750.0000	1960 AFRDTE
1552.9000	1334.0000	1961 AFRDTE
2403.2000	1637.0000	1962 AFRDTE
3632.1000	3439.0000	1963 AFRDTE
3458.7000	3627.9000	1964 AFRDTE
3117.3000	3210.9000	1965 AFRDTE
3109.4000	3153.9000	1966 AFRDTE
3116.8000	3058.1000	1967 AFRDTE
3251.2000	3293.6000	1968 AFRDTE
3570.3000	3364.7000	1969RDTEAF
3060.6000	3561.2000	1970RDTEAF
2762.1000	2909.7000	1971RDTEAF
2912.9000	3017.0000	1972RDTEAF
3122.5000	3262.2000	1973RDTEAF

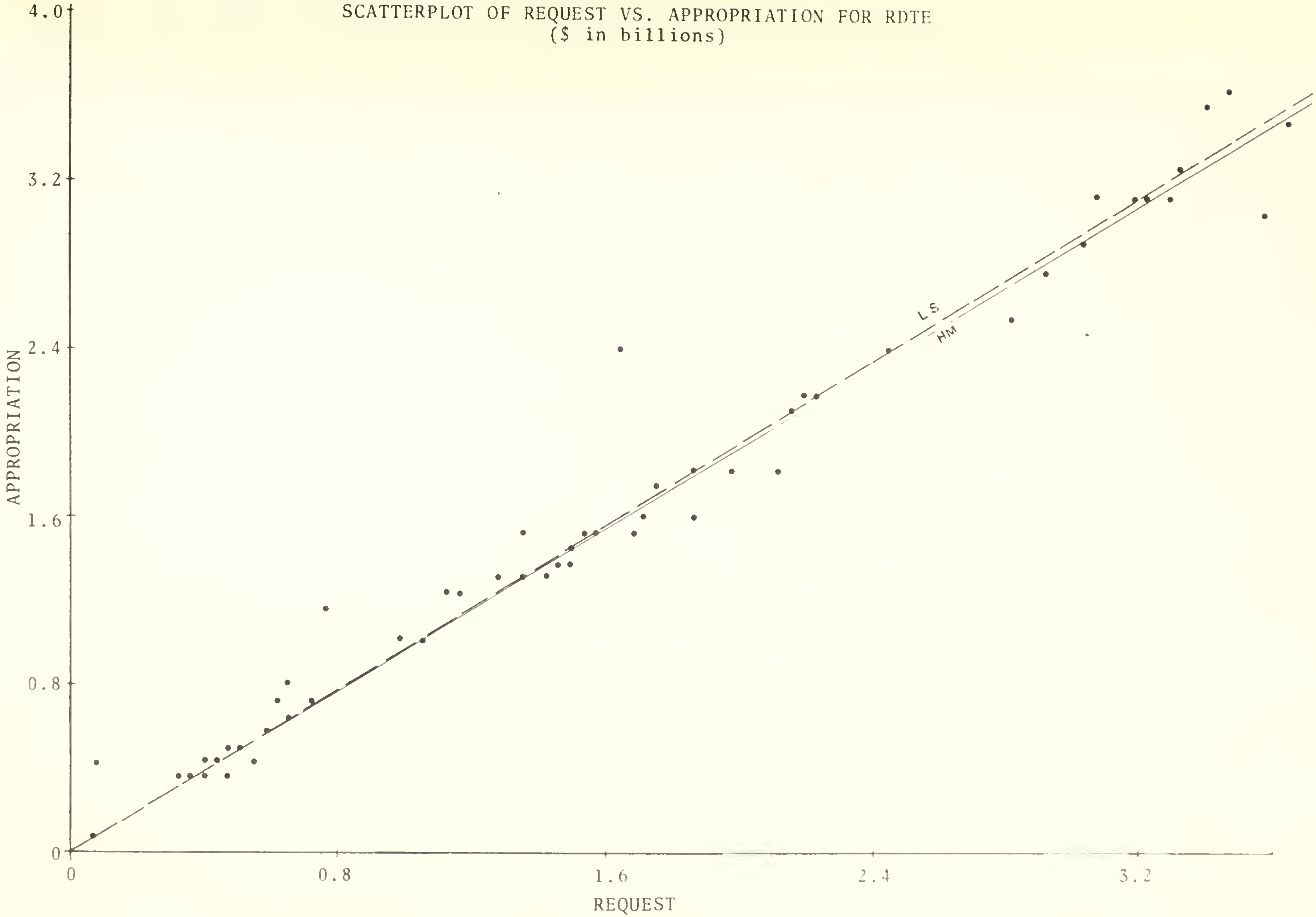
SCATTERPLOT OF REQUEST VS. APPROPRIATION FOR PROCUREMENT
($ in billions)



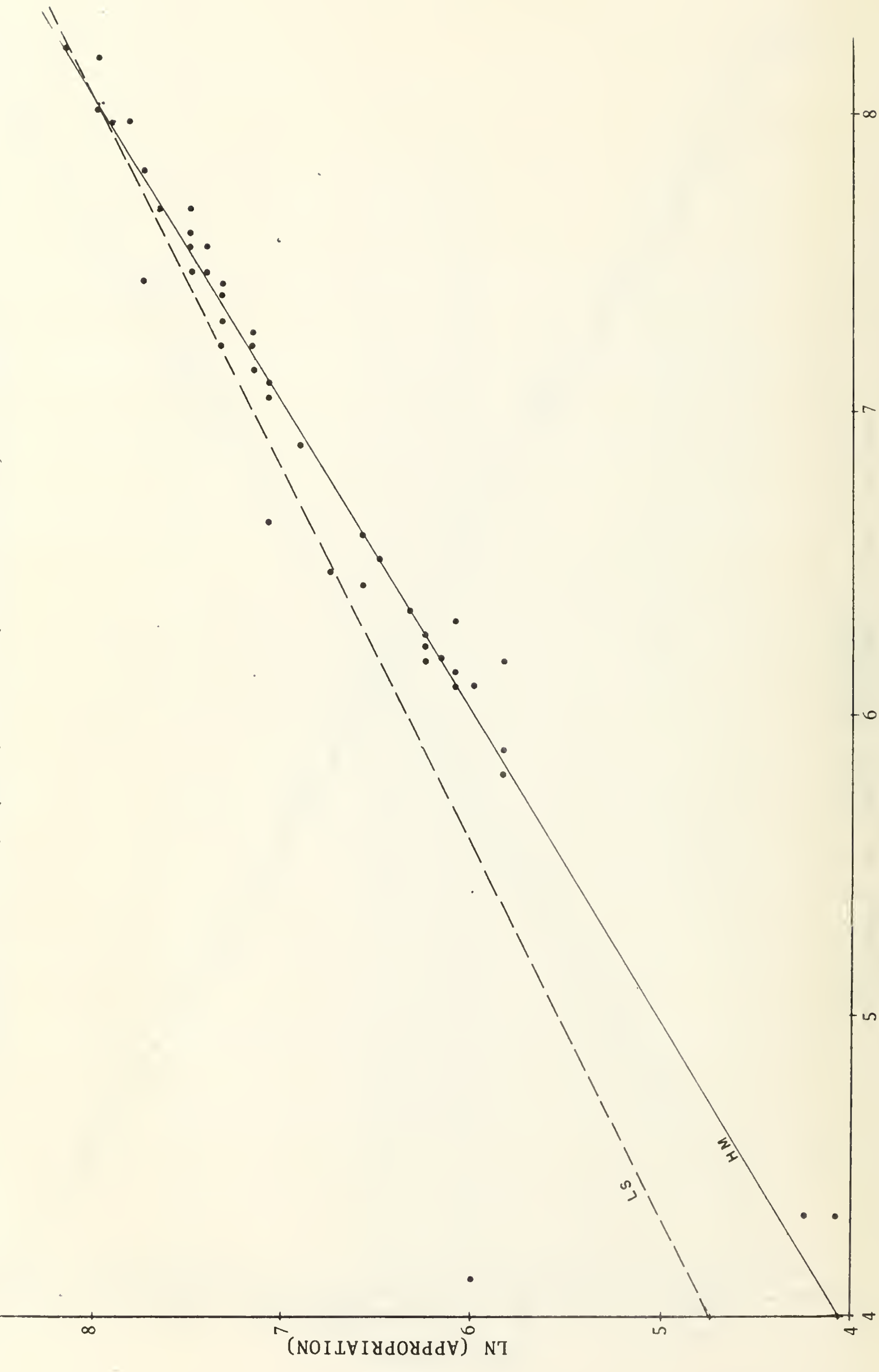
SCATTERPLOT OF LN (REQUEST) VS. LN (APPROPRIATION) FOR PROCUREMENT



SCATTERPLOT OF REQUEST VS. APPROPRIATION FOR RDTE
($ in billions)



SCATTERPLOT OF LN (REQUEST) VS. LN (APPROPRIATION) FOR RDTE



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